

REMARKS

The outstanding Official Action and cited art have been considered and the application amended as believed appropriate.

Independent claim 21 has been amended to incorporate the content of dependent claim 22. Claim 22 has been found by the examiner to be patentable over the prior art. Claims 23 - 29 are dependent claims that include by their dependency the content of claim 21 as amended. Claims 21 and 23 to 29 should now be allowable.

Independent claim 31 stands rejected as anticipated by the U.S. patent No. 5,353,001 of Meinel et al. Independent claims 13 and 14 stand rejected as obvious over the Meinel et al. patent in view of the U.S. patent No. 5,508,673 of Staszewski. Claim 1 has been amended to recite that the magnetic core has "a plurality in excess of two flux-conducting core arms" penetrating the circuit board and a plurality in excess of two flux-conducting magnetic core elements extending between the magnetic core arms in flux conducting relation therewith" and that the "core arms and core elements are serially linked to form a single, unbranched, closed flux path"

Independent claim 31 has similarly been amended to recite that the magnetic core has "a plurality in excess of two magnetic segments extending through the circuit board" and "a plurality in excess of two magnetic elements exterior of the circuit board" and forming "a single, closed, unbranched flux path."

Independent method claim 14 has been amended to call for "forming in excess of two holes through the printed circuit board," "locating magnetic core arms in each of the holes" and "locating magnetic core elements in flux-conducting relation between the core arms on opposite

faces of the printed circuit board to form a transformer core that has a single, unbranched, closed flux path incorporating each of the core arms and core elements."

Claim 13 has not been amended. It calls for "a plurality of at least four magnetic core segments extending through the board," "a plurality of at least four windings, each at least partially encircling a separate one of the core segments where the core segments extend through the board." Claim 13 goes on to state:

b) a plurality of substantially planar first magnetic core elements at the first side of the board, each of the first core elements extending between a pair of the magnetic core segments in flux-conducting relation thereto such that each core segment at the first side of the board is joined in flux-conducting relation to another of the core segments by one of the substantial planar core elements at the first side of the board; and

c) a plurality of substantially planar second magnetic core elements at the second side of the board, each of the second magnetic core elements at the second side of the board extending between a pair of the magnetic core segments in flux-conducting relation thereto, each pair of core segments between which a second magnetic core element extends at the second side of the board being in a separate pair of the core segments joined in flux-conducting relation by first magnetic core elements at the first side of the board.

Finally, claim 13 states:

the magnetic core elements and core segments forming an unbranched, closed magnetic flux path extending across the first and second faces and through the layers of the board.

Claim 10, formerly dependent from claim 1, has now been rewritten in independent form.

As it did before amendment, claim 10 calls for "the magnetic circuit element having an even number of core arms in excess of two.

The remainder of the rejected claims in this application are dependent claims incorporating by their dependency the subject matter set out in one of independent claims 1, 10, 14 or 31.

The primary reference relied upon by the examiner, Meinel et al., discloses a planar transformer 10 with a multilayer circuit board 11 and a magnetic core with segments 21, 22 that extend through holes 14A, 14B in the circuit board 11 and segments 18, 20 on each side of the board that connect the segments 21, 22 to form a single, closed flux path. Spirally wound windings 12, 13 are positioned around the holes 14A, 14B on the outer or inner surfaces of the multilayer board 11 (col. 3, lines 51 -60). Meinel et al. therefore discloses a magnetic circuit element with a core having two segments penetrating the multilayer board. But contrary to the invention, Meinel et al. does not disclose such magnetic circuit or core with a plurality in excess of two (or in the case of claim 10, four or more) magnetic core segments extending through the board. Neither does the Meinel et al. patent teach a winding on each of the more than two board-penetrating core arms or segments (claims 11, 13, 14) or forming a part of a single, unbranched, closed flux path (claims 1, 10, 13, 14 and 31) with more than two board penetrating core arms.

The Staszewski patent teaches a high frequency (>7 MHz) transformer. The transformer includes a circular core 40 and two windings 50, 52 on a first section 40a of the core 40 as well as two windings 54, 56 on a second section 40b of the core. The two windings 50, 52 are tightly electrically coupled and form a first 1:1 transformer. Also, the windings 54, 56 are tightly electrically coupled and form a second 1:1 transformer. Since the terminals 42 and 47, 43 and 45 as well as 44 and 46 are interconnected, the windings 50 and 54 are connected in series while the windings 52, 56 are connected in parallel. The result is a 1:2 transformer with two series connected primary windings and two parallel connected secondary windings (or vice versa). Staszewski, however, does not disclose a multilayer circuit board carrying the windings of the transformer. Accordingly, the core does not penetrate a board as claimed. The examiner cites Staszewski to show that there exist transformers with series connected primary and parallel

connected secondary windings. But this patent is not relevant regarding the other features of the claimed invention as discussed above in relation to Meinel et al. Combined, then, the Meinel et al. and Staszewski patents will not result in the invention as claimed in claims 1 - 21 and 24 - 32.

Claim 9 stands rejected as obvious over the Meinel et al. patent in view of Staszewski and further in view of the U.S. patent of Wolf et al. No. 6,650,217. This document discloses a planar magnetic winding structure with reduced winding losses. The windings are formed by winding layers 17, 18, 19 that are separated by insulating layers 20 - 25. The winding layers are arranged in stepped columns C1 - C7 in order to avoid windings in the "keep-away" region, which is a region around the air gaps between the E core part 15 and the I core part 16 (for example around point A as shown in Fig. 2a), such that the edges of the windings are at least a distance two or three times the height g of the air gap. This results in reduced losses due to fringing fields around these air gaps.

The Wolf et al. patent is cited to show the magnetic path made up of C and I segments. Again, this document does not disclose the windings being provided on the layers of a multilayer circuit board. Furthermore, the magnetic core does not form a single, unbranched, closed flux path having in excess of two core arms or segments penetrating a multilayer circuit board. This document is therefore not relevant regarding the main features of the invention. Again, the combining of Meinel et al., Staszewski and Wolf et al. cannot result in the invention as claimed in claim 9.

Applicant agrees that the closest prior art of record is the patent to Meinel. What delimits the invention from Meinel is the feature that the magnetic circuit includes more than two core segments extending through the board to form a single, unbranched, closed flux path. Multiple windings each of them at least partially encircling a separate one of the core segments can be

provided. The advantage of this feature compared with the prior art is, for example, that the number of layers of the printed circuit board PCB can be significantly reduced, because the core surrounds the windings and not vice-versa as in the prior art. Put another way, in an arrangement such as that of Meinel multiple primary and secondary windings are provided encircling an arm of the core by depositing or pinning the multiple windings on additional layers making up the circuit board. The inventive feature claimed particularly allows the manufacturing of very complex transformer arrangements even with multiple secondary windings that can be built using for example only two layers PCB.

The prior art of record neither deals with this problem nor teaches one to provide the claimed magnetic circuit with the goal of manufacturing complex transformer arrangements. Accordingly, it would not be obvious from the art cited as there is no suggestion to do so and no recognition of the improvement that can be achieved. The claimed invention, it is urged, is therefore patentable over the cited prior art.

Moreover, following the teachings of Meinel et al., one skilled in the art would depart from the invention, because on column 3, lines 51 - 57 and lines 60 - 65 Meinel teaches to increase the number of layers in order to increase the complexity of the transformer arrangement. *"Preferably, the winding 12 which appears in Fig. 2 is connected in series with several additional essentially identical spiral windings etched on other surfaces of the various layers of printed circuit board 11 to provide a sufficient number of turns around flow path opening 14A."* and *"Winding 13 in Fig. 2 also may be connected in series with other essentially identical etched spiral windings, respectively, on other surfaces of the various layers of printed circuit board 11 to provide more turns around flux path 14B."* Or, in other words, following the teachings of

Meinel, one skilled in the art would not arrive at the invention, but at a transformer arrangement with a much more complex circuit board with a much higher number of layers.

A two month extension of time in which to respond to the outstanding Official Action is requested in the accompanying Request for Extension, submitted in duplicate. A check in the amount of \$950.00 is enclosed. This is to cover the fee for the extension, one additional independent claim and two additional dependent claims. No further fee is believed necessary, however the Commissioner is authorized to charge any insufficiency or credit any overpayment to the deposit account number 070135 of attorneys for applicant.

Any questions or suggestions regarding the application or the amended claims submitted herewith should be directed to the undersigned attorneys for applicant at the telephone number listed below or by email to the email address listed below.

Respectfully submitted,

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